

What is claimed is:

1. A method for determining whether a network event changes a monitored path within an area of a multi-area routing domain, comprising:

receiving information corresponding to a first network event that may affect a path for one or more packets traveling in a multi-area routing domain, wherein the path is associated with a destination address;

maintaining a set of current candidate exit points out of a first area in the domain, wherein the candidate exit points are associated with the destination address;

determining whether the first network event caused the path to change;
and

if the first network event caused the path to change, identifying the network event as a cause for the path to change.

2. The method of claim 1, wherein the determining step comprises:

identifying a set of taken exit points within the set of current candidate exit points; and

determining whether the set of taken exit points changed after the occurrence of the network event.

3. The method of claim 1, wherein the determining step comprises:

maintaining a set of shortest paths associated with the current candidate exit points;

determining whether the set of shortest paths changed after the occurrence of the network event.

4. The method of claim 1, wherein if the first network event did not cause the path to change, receiving one or more second network events and repeating the determining and generating steps for the one or more second network events.

5. The method of claim 2 wherein a node in the first area is identified as a candidate exit point for a path in the area and towards a destination address if the node advertises in the area a longest matching route for the address.

6. The method of claim 2 wherein a node in the first area is identified as a taken exit point for a path in the area and towards a destination address if the node is a candidate exit point and is the actual exit point from the area used to reach the destination address.

7. The method of claim 1 further comprising determining whether the network event comprises shortest path events and exit point events.

8. The method of claim 1, wherein:

network events classified as shortest path events are used to determine if the shortest paths of exit points in the set of candidate exit points have been affected; and

network events classified as either shortest path events or exit point events are used to determine if the set of taken exit points or their shortest paths have been affected.

9. A method for identifying a root-cause event responsible for a change to a path within a multi-area routing domain, comprising:

receiving information corresponding to a first network event that may affect a path for one or more packets traveling in a multi-area routing domain;

maintaining a set of current candidate exit points for the path out of a first area;

determining whether the first network event is a shortest path event or an exit point event;

if the first network event is an exit point event, determining whether a set of taken exit points associated with the path has changed in response to the event; and

if the first network event is a shortest path event, determining whether the network event has changed either the set of taken exit points or a shortest path associated with at least one of the taken exit points.

10. The method of claim 9 wherein a node in the first area is identified as a candidate exit point for a path in the area and towards a destination address if the node advertises a longest matching route for the address in the area.

11. The method of claim 9 wherein a node in the first area is identified as a taken exit point for a path in the area and towards a destination address if the node is a candidate exit point and is the actual exit point from the area on a minimum total cost path used to reach the destination address.

12. The method of claim 9 wherein the network event is identified as the root-cause for a path change if either of the determining steps identifies the network event as having affected the set of taken exit points or their shortest paths.

13. The method of claim 9 wherein the step of determining whether the network event is a shortest path event or an exit point event comprises:

establishing if the first network event may affect any shortest path of any exit point in the set of current candidate exit points;

recomputing the shortest paths that may have been affected by the network event;

comparing the recomputed shortest paths to the original shortest paths to determine whether any shortest paths have changed; and

determining if the set of exit points taken by the path to exit the area has changed.

13. The method of claim 9 further comprising identifying the first network event as a root-cause for a path change if method identifies the network event as having affected either the set of taken exit points or their shortest paths.

14. The method of claim 12 wherein the establishing step comprises:

classifying the shortest path event in one of at least four categories;

if the network event is classified in a first category, further checking if the network event affected a link of a shortest path to a candidate exit point, and recomputing the shortest path if it did;

if the network event is classified in a second category, further checking if the network event affected a link of a shortest path to a candidate exit point, and recomputing the shortest path if it did not;

if the network event is classified in a third category, recomputing the shortest paths of all candidate exit points in the set of candidate exit points and;

if the network event is classified in a fourth category, further checking if the shortest path event affected a link or a node of a shortest path to a candidate exit point, and recomputing the shortest path if it did.

15. The method of claim 14 wherein a network event is classified in the first category if it corresponds to an increase in the cost of a link in the area.

16. The method of claim 13 wherein a network event is classified in the second category if it corresponds to a decrease in the cost of a link in the area.

17. The method of claim 14 wherein a network event is classified in the third category if it corresponds to a link coming up in the area.

18. The method of claim 14 wherein a network event is classified in the fourth category if it corresponds to a link going down in the area.

19. The method of claim 12 wherein the determining step comprises:

extracting a set of chosen exit points from the set of candidate exit points;

determining if the set of chosen exit points has changed;

if the set of chosen exit points has not changed, identifying if the shortest paths of the chosen exit points have changed;

if either the set of chosen exit points or their shortest paths have changed, identifying the set of taken exit points used by the path to exit the area;

if the set of taken exit points used by the path to exit the area or their shortest paths have changed identifying the shortest path event as the root-cause for a path change.

20. The method of claim 19 wherein the step of extracting the set of chosen exit points from the set of candidate exit points comprises:

computing for each candidate exit point a total cost to the destination by adding the cost of the shortest path to the candidate exit point to the cost from the candidate exit point to the destination;

identifying the candidate exit points that correspond to the minimum total cost to the destination;

selecting as chosen exit points candidate exit points that have a minimum total cost to the destination.

21. The method of claim 12 wherein the determining step comprises:

determining if the exit point event is a change of cost for reaching the destination through one of the candidate exit points that affects the selection of taken exit points for the area;

identifying if the exit point event corresponds to the advertisement of a best matching route that affects the selection of taken exit points from the area.

22. The method of claim 21 wherein the determining step comprises:

determining if the exit point event is a cost decrease on a chosen exit point or a cost increase on a non-chosen exit point;

if the exit point event is neither a cost decrease on a chosen exit point nor a cost increase on a non-chosen exit point, updating the total cost of the paths to the destination through the candidate exit points affected by the exit point event;

identifying the set of chosen exit points;

if the set of chosen exit points have changed, identifying the set of taken exit points and their shortest paths;

examining if the set of taken exit points or their shortest paths have changed.

23. The method of claim 21 wherein the identifying step comprises:

deciding if the exit point event is a best matching route for the destination address;

updating the set of candidate exit points based on the best matching route for the destination address;

determining if the set of candidate exit points have changed;

if the set of candidate exit points has changed, computing shortest paths to the new candidate exit points and selecting chosen exit points;

determining if the set of chosen exit points has changed or if new candidate exit points belong to the shortest paths of chosen exit points;

identifying taking exit points and their shortest paths;

examining if the set of taken exit points or their shortest paths have changed.